**Remarks**

Application Status and Disposition of Claims

The Final Action considered claims 1, 3-13, and 15-18.

With this amendment, claim 1 is amended to include the elements of claims 8 and 10; claims 8 and 10 are canceled; claims 11 and 12 are amended for clarity and to correct their dependencies. This amendment finds support in previous claims 8 and 10.

Claim 9 is amended for clarity and the amendment finds support in the claim and throughout the specification.

New claims 19-28 are added. New claims 19-28 find support throughout the specification and previous claims.

The amendments do not add new matter.

Claim Rejections – 35 U.S.C. § 103

The Final Office Action rejects claims 1, 3-13, and 15-18 under 35 U.S.C. 103(a) as allegedly being unpatentable over Saito et al. (WO 03/026835, with specific reference made through Saito et al. (US 2004/0250919)) in view of an English language abstract of Nakajima et al. (JP-05-000391). Applicants respectfully disagree with the rejections for the reasons that follow.

Initially, Applicants respectfully submit that there are structural features of the present claim that are not being given the structural weight to which they are entitled. For example, claim 1 is directed to a "solder composition made of a uniform mixture of *a liquid substance* and solder particles; wherein the liquid substance is a fatty acid ester and comprises a flux component which reacts at a melting point of the solder particles; *the mixture of the liquid substance and solder particles has a viscosity that flows at room temperature and deposits in layers on a base material*; and the solder particles are mixed in the liquid substance at room temperature, and are *granular agents that precipitate in the liquid substance towards the base*

*material*, having a mixing ratio and a particle diameter to be uniformly dispersible within the liquid substance, wherein the mixing ratio of the solder particles is less than or equal to 30wt%." (Emphasis added.) Thus, the presently claimed composition requires a liquid substance and solder particles that flow sufficiently at room temperature so as to deposit in "layers" on a base material and the solder particles "precipitate" or settle in the liquid substance towards the base. In other words, the liquid substance must be sufficiently *non*viscous so as to allow for the settling or precipitation of the solder particles on the base on which the composition is applied.

That the claim is directed to these features and has these meanings is quite clear from the specification.

As explained in the present specification, paste solders suffer a number of problems.

[0005] The solder paste has been used in the conventional solder bump forming. However, the solder paste has the following problems.

[0006] (1) Equipments such as a printing machine or a dispensing machine are required to apply the solder paste on the substrate, and it takes time and effort to perform printing or dispensing of the same to an accurate position. For example, even if a precise mask becomes unnecessary by being applied entirely, a step for forming the thickness of the solder paste uniformly by using a squeegee, a doctor blade becomes necessary.

[0007] It has become difficult with the screen printing and dispensing method to cope with more densification, micronization and increased number of electrodes these days. That is, the screen printing needs to micronize the opening of a metal mask, which causes such issues that the mechanical strength of the metal mask is deteriorated and it becomes hard for the solder paste to be ejected from the opening of the metal mask. In the dispensing method, the solder paste is applied on a large number of pad electrodes one by one. Thus, it becomes unsuitable for mass production as the number of pad electrodes increases.

[0008] In the meantime, it is necessary for the solder paste of Patent Literature 1 to form the thickness of the oxide film of the solder particles with a fine precision. The reason is that the solder is not wetted over the pad electrode when the film is too thick, and the solder particles are united with each other when it is too thin. Moreover, the effect of the flux changes in accordance with the state or the kinds of the flux, so that it is also necessary because of these reasons to control the thickness of the oxide film with a fine precision. Meanwhile, densification and micronization of the pad electrodes cannot be achieved without forming the oxide film in a proper film thickness.

The present inventors have solved the aforementioned problems by the use of the presently claimed solder composition.

> [0009] An object of the present invention is to provide a solder composition and a method of bump formation therewith that simplifies the step for applying solder paste on a substrate. A further object of the present invention is to provide a solder composition and a method of bump formation therewith that does not require a step for forming an oxide film of solder particles, thereby simplifying the manufacturing step and reliably achieving densification and micronization of the solder bump.
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> [0010] In order to achieve the above object, the solder composition used in the present comprises a mixture of a liquid substance and the solder particle. The liquid substance contains a flux component whose reaction temperature is close to the melting point of the solder particle, which has such a viscosity that it flows at a normal temperature and spread evenly on a base material. The solder particles are granular agents that precipitate in the liquid substance towards the base material, having the mixing ratio and the particle diameter to be uniformly dispersible within the liquid substance.
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> [0011] In the solder composition according to the present invention, the liquid substance containing the flux component flows at a normal temperature and spread evenly on the base material. It is therefore completely different from the solder paste in this respect. In order to attain such characteristic (flow characteristic), it is necessary for the liquid substance to have low viscosity at a normal temperature, the mixing ratio of the solder particles to be low, and the particle diameter of the solder particle to be small. . . .

Thus, as explained above, the prior art pastes are too thick to achieve the necessary flow to achieve the objects of the present invention. The Office Action relies on Saito et al. for this feature of Applicants' claims. However, it is clear from the disclosure of Saito et al. that its composition is a "paste." Applicants respectfully maintain that Saito et al.'s composition is not one that flows at room temperature such that it *deposits in layers on a base material* or that the solder particles are *granular agents that precipitate in the liquid substance towards the base material*. Applicants respectfully submit that the composition of Saito et al. is too thick to allow for these claimed features.

Applicants submit that the Action appears to misinterpret Saito et al. in rejecting the claims. (Applicants note that the Final Action appears to be incomplete (see section 5d on page 3 of the Final Action) and thus, refer to the Office Action mailed December 21, 2009 for the

specific points of rejection.) The Action (mailed December 21, 2009) states in section 4a that Saito teaches a solder flux composition for use in electronic components and a method of soldering using the same, wherein the liquid substance contains a flux component and a tin alloy. (Citations omitted.) To be clear, Saito et al. actually teaches a flux composition and a solder paste containing the flux composition and solder powder. (See, for example, paragraphs [0010], [0018], and [0110].) Thus, to the extent that one would attempt to read the present claims on Saito et al., one would have to read the claims on Saito et al.'s paste, as Applicants' claims require solder particles and only Saito et al.'s paste contains solder particles.

The Office Action (mailed December 21, 2009) states that Saito et al.'s mixture of liquid substance and solder particles has a viscosity that flows at room temperature, referring to paragraph [0117], "where Saito teaches a solder past which can be applied by 'flowing or dipping,' paragraph 0118, where the method of soldering may be 'performed by an ordinary method under ordinary conditions, and Table 1, synthesis example 3 and paragraph 0122, where one embodiment expressly taught has a viscosity of 0.1 poise at 25°C." To be clear, Applicants reproduce paragraphs [0117] and [0118] as follows:

> [0117] The methods of soldering according to the present invention are a method including the steps of (A) providing the flux composition on an electrode portion of a substrate, (B) providing a solder bumped electronic component, (C) placing the electronic component provided in step (B) on the substrate obtained in step (A), and (D1) subjecting the substrate with the electronic component obtained in step (C) to reflow for mounting; a method including step (A), and step (D2) of supplying solder onto the substrate with the flux composition obtained in step (A), by flowing or dipping; and a method including the steps of (X) printing the solder paste of the present invention on an electrode portion of a substrate, (Y) placing an electronic component on the substrate obtained in step (X), and (Z) subjecting the substrate with the electronic component to reflow for mounting.
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> [0118] In the methods of soldering according to the present invention, each step may be performed by an ordinary method under ordinary conditions, as long as the flux composition or the solder paste according to the present invention is used as the flux or the solder paste.

It is clear from reading paragraph [0117] that the "flowing or dipping" referred to in the Action is flowing or dipping of the flux composition – not the paste. This distinction is made clear by the fact that the next clause in paragraph [0117] refers to "printing the *solder paste*." Thus, the

Action's support for its conclusion that Saito et al.'s paste flows at room temperature, i.e., that it can be applied by flowing or dipping, is actually a description of the flux composition – not the paste. Thus, the Action's conclusion is without support.

As further support for its conclusion that Saito et al.'s paste flows at room temperature, the Action refers to "Table 1, synthesis example 3 and paragraph 0122, where one embodiment expressly taught has a viscosity of 0.1 poise at 25°C." Applicants note that Synthesis Example 3 relates to a flux composition, not to a solder paste. A survey of all of Synthesis Examples 1-14 and Examples 1-1 – 1.17 show that none includes a solder powder, which is required by the present claims and by Saito et al.'s description of solder "paste." In this regard, note that Examples 2-1 – 2-23 (paragraph [0139]) show that a "solder paste was prepared by kneading a flux . . . with fine pitch solder powder." Thus, again, the Action's support for its conclusion that Saito et al.'s paste has a low viscosity is misplaced – 0.1 poise refers to the flux composition not the paste. Moreover, that the paste was prepared by "kneading" strongly suggests that the paste itself had a much higher viscosity.

Thus, the Action's conclusions that Saito et al. discloses a composition that flows at a normal temperature and that deposits in layers on a base material and that includes solder particles that precipitate in the liquid substance toward a base material are based upon a faulty premise – that Saito et al. discloses a paste having a low viscosity. The Action states that precipitation of solder particles in a liquid substance is an "inherent characteristic of a tin powder suspended in an organic liquid under the influence of gravity." (Office Action mailed December 21, 2010, page 3, lines 12-14.) Applicants submit that this conclusion is, for the reasons explained above, based upon a misinterpretation of the disclosure of Saito et al. Moreover, the assertion of inherency is without basis – whether a tin powder will settle in a complex mixture of organic components (not a single liquid, as suggested by the Action) will depend upon the viscosity of the mixture. Thus, the assertion of inherency – in which the law requires that the action *necessarily* occur – is without foundation.

Moreover, Applicants also wish to point out that all of the examples of Saito et al. use 90% by weight solder powder – which explains the need for "kneading" the composition. Paragraph [0112] explains that the flux component of the paste should be 1-50%, more

specifically 5-30%, and even more specifically 5-15%, with the remaining content being solder powder. Thus, Applicants respectfully submit that the thick paste compositions would not exhibit the characteristics required by the present claims.

For at least the foregoing reasons, Applicants submit that Saito et al. fails to teach or suggest the discussed recited components of the presently claimed invention, and for these reasons, the rejection is improper and should be withdrawn.

Applicants also wish to note that Saito et al. specifically states in paragraph [0112] that with "less than 50 wt% or more than 99 wt% solder powder, *required* solder printability is not obtained, thus not being preferred." (Emphasis added.) Applicants respectfully submit that, at least in view of this paragraph (as well as the remainder of Saito et al.'s teachings), a person skilled in the art would not be led to modify Saito et al.'s teachings to use an amount of solder particles of less than 30 wt%. Saito et al. very clearly explains in this paragraph that having a high weight percent of solder particles is critical to the practice of the invention – "required solder printability is not obtained" if that less than 50 wt% solder powder is used.

The law clearly states that if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). Applicants also note that the law states that if the proposed modification of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). Applicants submit that these sorts of changes or modifications are exactly what the Office Action asserts would be obvious. This is clearly counter to the law.

Even putting this issue aside, the Action fails to provide any reasonable explanation for why one would choose Nakajima et al.'s lower weight percent of solder powder. The Action makes an ambiguous reference to "in order to obtain the required tackiness and viscosity," apparently suggesting that one skilled in the art would choose Nakajima et al.'s weight percent of solder powder to achieve a desired tackiness and viscosity. However, this is hardly a reason to

*replace* Saito et al.'s required 50 weight percent or greater of solder powder. Saito et al. clearly contemplated values as low as 50 wt%, but very clearly stated that higher concentrations were more preferred to achieve the printability. Presumably, tackiness and viscosity are characteristics that were considered by Saito et al. in its conclusion that a higher concentration is better. It is simply unreasonable to suggest that Nakajima et al.'s suggestion that *for its intended purposes* a weight concentration of 45% or less solder powder is desirable would somehow trump Saito et al.'s indication that *for its intended purposes* a concentration of greater than 50% is desirable.

For at least these reasons, Applicants respectfully submit that a person skilled in the art would not have combined the teachings of Saito et al. and Nakajima et al. as suggested by the Office.

Finally, though Applicants submit that the pending claims clearly patentably distinguish over the cited art, Applicants note that new claims 19-28 have been added, and that these claims are novel and nonobvious over the cited art.

Conclusion

In view of the foregoing amendments and remarks, the Examiner is respectfully requested to reconsider the objections and rejections of record, and allow each of the pending claims.

If any issues yet remain which can be resolved by telephone, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

Respectfully Submitted,
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